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A possible inverted riverbed in NE Eridania basin, Mars. Origin and timing of fluvial activity

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Abstract

The Eridania paleolakes system, located along the 180° meridian at the boundary of Terra Cimmeria and Terra Sirenum (Fig. 1), is considered to be one of the largest lacustrine environments that were once present on Mars [1]. Morphological features suggest that it was constituted by three major connected depressions [2-4] filled by water to maximum depths of ~2400 m and a volume of at least 562000 km^3 [5]. Such body of water exceeded the volume of all other lakes on Mars combined [6], but due to the lack of major tributaries flowing into this basin, its existence is believed to have been related to groundwater springs, with minor contributions from overland flow [7]. Several sedimentary mineralogies have been recognized there (e.g. [8,9]) supporting the interpretation of i) a low-energy and long lasting (Late Noachian to Early Hesperian) depositional environment characterized by the presence of ponding water and ii) a warm Martian paleoclimate with a stable highland water table more than ~3.5 billion years ago [1,8].

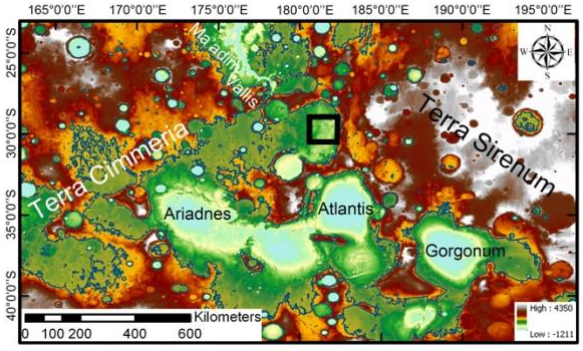

Figure 1: MOLA elevation map showing the Eridania paleolake system. The black box corresponds to the extension of Fig. 2. The blue contour line indicates the 950 m MOLA elevation that corresponds to the Eridania lake shoreline suggested by [5].

In this work we focused our attention on the north-eastern side of the Eridania Basin, over an area located between 181°E and 182°E longitude and 29°30'S - 31°30'S latitude. This region is particularly interesting because there is evidence of a sinuous feature, currently presenting inverted relief, with an overall NW-SE direction, being composed of N-S and W-E tracts (Fig. 2). The western end is unclear, being currently covered by the basaltic lavas that cover the vast majority of the Eridania basin [8]. To the east, such feature extends up to a low-lying area, where several sediments spread. The length of the inverted feature's course is at least 38 km and its thickness never exceeds 20 m, despite the fact that it may have been eroded to an unknown extent. Given it properties we interpret this feature as a possible inverted paleoriver, whose source is unknown, but that seems to have sedimented deposits in a relatively small and closed basin with a presumed delta fan. Such sediments spread over an area of 9.08 x 10^2 km^2, locally showing evidence of layering, testifying the occurrence of multiple phases of sedimentation. The catchment of the ancient riverbed and its drainage basin is unclear, since volcanic capping units completely cover the area to the west; nevertheless, the occurrence of a channel and possible delta over this location is of particular importance because it may highlight the presence of a late-stage fluvial activity while the full body of water in Eridania was vanishing. The presumed delta fan itself is topographically open towards lower elevation inside the E-SE basin and its elevation suggests the presence of paleolake with a minimum depth of about 20 m (vertical drop from the mouth of the river to the eastern low-lying area) with a surface of at

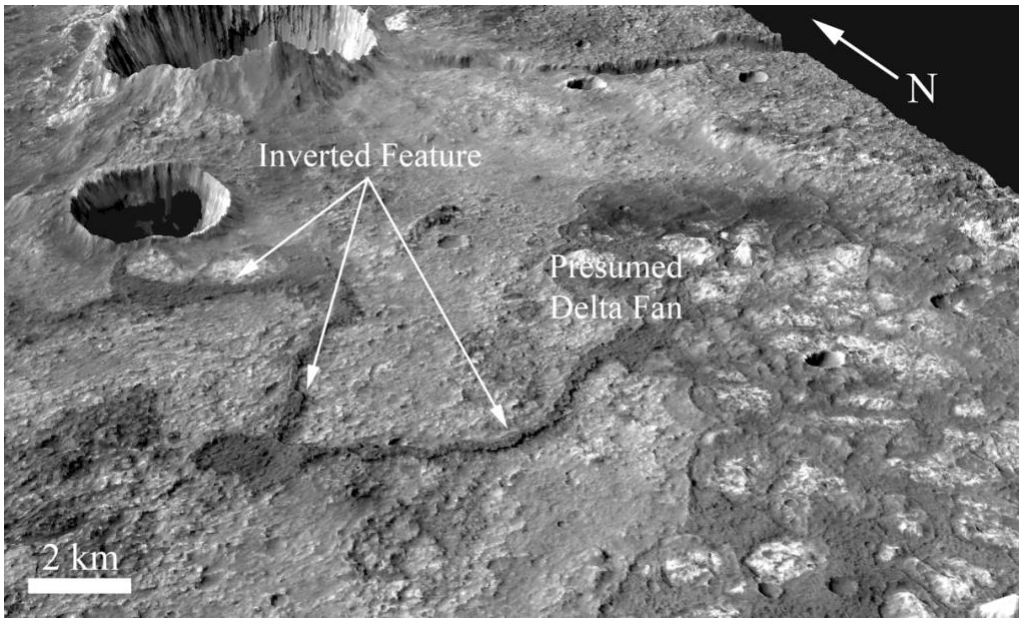

Figure 2: CTX image overlaid on a CTX DTM showing the inverted feature that we interpret as a paleoriver together with the presumed delta fan identified in the NE Eridania basin. The North direction is also indicated.

least 1000 km^2 (part of the deposits is currently buried by Amazonian-Hesperian lava flows [8]). Over the full study area, the high-albedo patches of Fe and Mg clays sedimented on the ancient Eridania seafloor intermix with the dark deposits brought inside the late stage paleolake. By using the CTX 5.5 m resolution images covering the area [10] we counted all craters situated on such deposits and estimated a modeled age of 3.45 +0.03/-0.04 Ga ago. This should point out to the final timing when the late stage body of water vanished from this basin.

Acknowledgements

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